DEXIS®

DICOM Conformance Statement
3.0

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1 INTRODUCTION

This chapter provides general information about the purpose, scope and contents of this Conformance Statement.

1.1 SCOPE AND FIELD OF APPLICATION

The scope of this DICOM Conformance Statement is to facilitate data exchange with the DEXIS® X-ray system and the DEXIS Software suite. This document specifies the compliance to the DICOM 3.0 standard. It contains a short description of the applications involved and provides technical information about the data exchange capabilities of the equipment. The main elements describing these capabilities are: the supported DICOM Service Object Pair (SOP) Classes, Roles, Information Object Definitions (IOD) and Transfer Syntaxes.

The field of application is the integration of the DEXIS equipment into an environment of other medical devices and practice management software. This Conformance Statement should be read in conjunction with the DICOM 3.0 standard and it's addenda.

1.2 INTENDED AUDIENCE

This Conformance Statement is intended for:

- system integrators of medical equipment,
- software designers implementing DICOM interfaces.

It is assumed that the reader is familiar with the DICOM 3.0 standard.

Readers wishing to obtain more familiarity with the content and terminology of DICOM 3.0 standard are encouraged to obtain and review the standard prior to reading this Conformance Statement. More information on acquiring this document and its updates on the DICOM standard may be found on the website of the National Electrical Manufacturer's Association (NEMA) at http://www.nema.org.

1.3 Contents and Structure

The DICOM Conformance Statement is contained in chapters 2 through 8 and follows the contents and structuring requirements of DICOM PS 3.2-2003.

1.4 Revision History

Revision	Date	Description	Person
1.0	5 Nov. 2000	Initial Draft	M. Pfeiffer
2.0	1 Nov. 2002	Adaptation to CD-R Image Inter-change Profile	H. Feuerhahn
3.0	30 April 2004	Addition of Networking Features	H. Feuerhahn

1.5 Definitions, Terms and Abbreviations Used

AE   DICOM Application Entity
CR   Computed Radiography
DICOM   Digital Imaging and Communications in Medicine
FSC   File Set Creator
FSR   File Set Reader
FSU   File Set Updater
IOD   DICOM Information Object Definition
RWA   Real-World Activity
SCP   Service Class Provider
SCU   Service Class User
SOP   Service-Object Pair
Tag   A 32 bit integer consisting of a group/element pair
UID   Unique Identifier
VM   Value Multiplicity
VR   Value Representation

1.6 References

DICOM standard:

PS 3.2-2003   Conformance
PS 3.3-2003   Information Object Definitions
PS 3.4-2003   Service Class Specifications
PS 3.5-2003   Data Structures and Encoding
PS 3.6-2003   Data Dictionary
PS 3.7-2003   Message Exchange
PS 3.8-2003   Network Communication Support for Message Exchange
PS 3.10-2003   Media Storage and File Format for Media Interchange
PS 3.11-2003   Media Storage Application Profiles

1.7 TRADEMARKS

DEXIS is a registered trademark in the USA, UK, France, Germany, Belgium, Switzerland, Netherlands, Luxemburg, Sweden, Spain, Italy.

1.8 CONNECTIVITY AND INTEROPERABILITY

This Conformance Statement by itself does not guarantee successful interoperability of DEXIS equipment with non-DEXIS equipment or non-DEXIS software. The user (or the user's agent) should be aware of the following issues: The implementation of the DEXIS DICOM interface has been carefully tested to assure correspondence with this Conformance Statement. But the Conformance Statement by itself and the DICOM standard does not guarantee interoperability of DEXIS modalities and modalities of other vendors. The user (or the user's agent) must compare the relevant Conformance Statements and if a successful interconnection should be possible, the user is responsible to specify an appropriate test suite and to validate the interoperability, which is required. A network environment may need additional functions out of the scope of DICOM.

2 IMPLEMENTATION MODEL

The DEXIS SOFTWARE Release 6 is a comprehensive range of software modules that allow for tailored solutions in the dental imaging field. The software applications are categorized in packages, for instance the DEXwrite package for referral letters. The Application Entities responsible for exchanging data through the DICOM interface are:

- The **DEXIS Import/Export Application Entity** is integrated into the DEXray and DEXimage packages. It deals with the exchange of images through removable media.

- The **DEXcom Application Entity** is integrated into the DEXIS Administration package. It deals with the exchange of images through computer networks using the DICOM standard.

Through these two Application Entities the DEXIS Software provides the following DICOM data exchange features:

- DEXIS can export DICOM File Sets to removable media; it thus serves as DICOM File Set Creator (FSC). If the images are not internally stored in DICOM file format, they are converted when exported.

- DEXIS can browse through DICOM File Sets on removable media and can import images from these file sets; it thus serves as DICOM File Set Reader (FSR).

- DEXIS can verify communication with a DICOM server; it is thus a Service Class User (SCU) of the Verification Service Class.

- DEXIS can store images on a DICOM server; it is thus a Service Class User (SCU) of the Storage Service Class.

- DEXIS can query DICOM servers for patients, studies, series, and images; it is thus a Service Class User (SCU) of the Query/Retrieve Service Class.

- DEXIS can receive images from a DICOM server and store them in its local database; during this operation it serves thus as a Service Class Provider (SCP) of the Storage Service Class.

- DEXIS can query Modality Worklist Servers for entries; it is thus a Service Class User (SCU) of the Modality Worklist Service Class.

2.1   Application Data Flow Diagrams

2.1.1   Removable Media

The DICOM import and export functionalities for the CD-R device are handled by the DEXIS Import/Export Application Entity (AE). The DEXIS Import/Export Application Entity is commanded by the user to perform DICOM services oper-

ating on the DICOM media through the use of buttons and menu selections on the graphical user interface of the station.

The user requests the creation of a DICOM file set by selecting the images in the list displayed by the export function and by selecting DICOM as the file format. By selecting a drive and optional folder the file set can either be created directly on a removable media (CD-R) or in some temporary folder on the hard disk and written to CD-R by selecting images in the local Browser, and by a drag and drop of those images on the CD-R icon.

The user can request the reading of a DICOM file set written on a CD-R by selecting the CD-R drive in the browser of the import function, and browsing the archive using the displayed folders and files. He can then import the selected items by double-clicking on them or by selecting them and clicking the "Import" button.

For the purpose of this Conformance Statement import and export is restricted to CD-R media, but the same methods can be applied to other removable media.
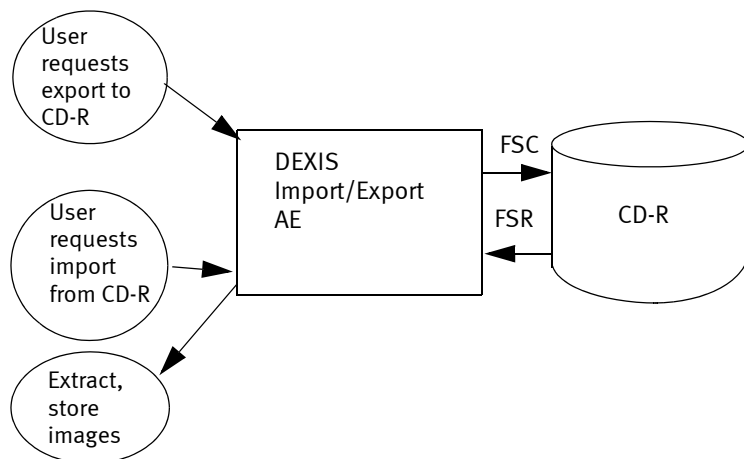
2.1.2 Networking

The DICOM networking functions are handled by the DEXcom Application Entity (AE). The DEXcom Application Entity is commanded by the user to perform DICOM services through the use of buttons and menu selections on the graphical user interface of the station. Some of the functions can be set to work automatically.

When new images are acquired, they are stored in the local database. If the preferences of the DEXcom component are set so, all newly acquired images are copied automatically to one or more DICOM Storage Servers. Storage of images to specific servers can also be invoked by the user through menus.

Through a user interface dialog the user can enter queries for patients, studies, series, or images present on a DICOM Server. He can then - based upon the displayed query result - select images, studies, or patient files to be retrieved from the the server. The retrieved items are then entered into the local image database.

If a Worklist server is present, the user can enter queries to it to either obtain the whole Modality Worklist, or specified parts of it.

Local   Remote
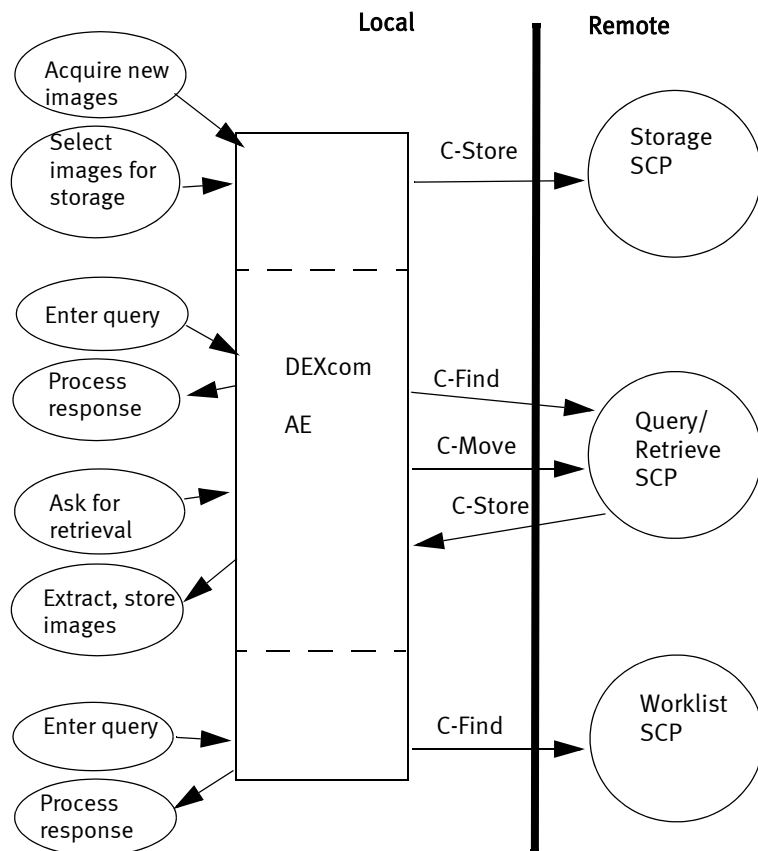
2.2   Functional Definition of Application Entities

The DEXIS Import/Export Application Entity supports the following functions:

• Can write a DICOM File Set (FSC) on a CD-R.

• Can read a DICOM File Set (FSR) on a CD-R.

The DEXcom Application Entity acts as a service class user (SCU) in the following roles:

• SCU of the Verification Service Class (C-Echo operations)

• SCU of the Storage Service Class (C-Store operations)

• SCU of the Query / Retrieve Service Class (C-Find and C-Move operations)

• SCU of the Worklist Management Service Class (C-Find operations)

The DEXcom Application Entity acts as a service class provider (SCP) in the following role:

• SCP of the Storage Service Class (during C-Move operations only)

2.3   Sequencing Requirements

Non applicable.

2.4   General Meta Information Options (see PS 3.10)

Implementation Class UID (0002,0012)='1.2.840.114059.1.1.6.1.50.1'.

Implementation Version Name (0002,0013)='DEXIS20021101'.

3   Application Entity Specifications

3.1   DEXIS Import/Export AE Specification

The DEXIS Import/Export Application Entity provides conformance to the Media Storage Service Class according to the following table

3.1.1 File Meta Information for the DEXIS Import/Export AE

Supported Application Profiles	Real World Activity	Role	Service Class Option
STD-GEN-CD	Export to CD-R	FSC	Interchange
STD-GEN-CD	Import from CD	FSR	Interchange

3.1.2 Real-World Activities for this Application Entity

3.1.2.1 Real-World Activity: Export to CD-R

The DEXIS Software acts as an FSC using the interchange option when requested to copy SOP Instances from the local data base to the CD-R.

3.1.2.1.1 DICOM Directory

The DEXIS Software writes directory records Patient, Study, Series and Image. Images are referenced via the Image Directory Entry attribute Referenced File ID (0004,1500). DEXIS does not employ Multi-Referenced Directory Entries.

3.1.2.1.2 SOP Specific Conformance

The file sets created by the DEXIS Software can contain information objects of the following SOP Classes:

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Media Storage Directory Storage	1.2.840.10008.1.3.10	Explicit VR Little Endian	1.2.840.10008.1.2.1
Digital X-ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Explicit VR Little Endian	1.2.840.10008.1.2.1

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Digital Intra-oral X-ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Explicit VR Little Endian	1.2.840.10008.1.2.1
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Explicit VR Little Endian	1.2.840.10008.1.2.1

3.1.2.2 Real-World Activity: Import from CD-R

The DEXIS Software acts as an FSR using the interchange option when requested to copy SOP Instances from the CD-R to the local data base.

3.1.2.2.1 DICOM Directory

The Import function of the DEXIS Software serves to import image file in all formats known to the software. If inside this function a location is selected that contains a valid DICOM data set, the DICOMDIR file is listed. When the user clicks on the DICOMDIR entry, all image files and descriptive information (patient name, image date, anatomic region) are listed, and the user can select the image files to import. If the patient names do not match, the user is asked for confirmation.

There are no requirements or restrictions on the contents of the DICOMDIR. If the DICOMDIR is missing, the media can be browsed and the individual image files can be imported anyhow.

3.1.2.2.2 SOP Specific Conformance

The Import function of the DEXIS Software accepts information objects of the following SOP Classes:

SOP Class Name	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Digital X-ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2

SOP Class Name	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Digital X-ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
Digital Intra-oral X-ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
Digital Intra-oral X-ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
Computed Radiography Image	1.2.840.10008.5.1.4.1.1.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2

3.2   DEXcom AE Specification

The DEXcom AE provides standard conformance to the following Service Object Pair (SOP) Classes.

SOP Class Name	SOP Class UID
Digital X-ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Intra-oral X-ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra-oral X-ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1

SOP Class Name	SOP Class UID
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2
Patient Root Query/Retrieve Information Model - Find	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - Move	1.2.840.10008.5.1.4.1.2.1.2
Modality Worklist	1.2.840.10008.5.1.4.31
Verification	1.2.840.10008.1.1

3.2.1 Association Establishment Policies

3.2.1.1 General

All associations with DEXcom are established using the DICOM 3.0 Standard application context. The maximum length PDU that DEXcom will support is 16,384 bytes.

3.2.1.2 Number of Associations

DEXcom opens one association at a time. Multiple simultaneous associations are not supported.

3.2.1.3 Asynchronous Nature

Asynchronous operations are not supported.

3.2.1.4 Implementation Identifying Information

The Implementation Class Unique Identifier (UID) for the DEXcom Application Entity (AE) is:

 2.16.840.1.114059.1.1.6.1.50.1

The Implementation Version Name for the DEXcom AE is:

DEXIS20040430

3.2.2 Association Initiation by Real-World Activity

The DEXcom Application Entity attempts to initiate an association for the appropriate DICOM Service Class.

The association is closed when one of the following has occurred:

• all the images have been sent to the remote application (Storage)

• all the images have been received from the remote application (Retrieve)

• the Query results have been received from the remote application (Query and Worklist)

The client is also able to abort the association when a timeout or an error occurs.

3.2.2.1 Real-World Activity for Send Image Operations

DEXcom initiates associations for the transfer of images to a DICOM Image Storage Server.

3.2.2.1.1 Associated Real-World Activity for Send Image Operations

Once the Storage association has been established, a C-STORE message is sent by DEXcom.

3.2.2.1.2 Proposed Presentation Contexts for Send Image Operations

The presentation contexts that are proposed by DEXcom for the Send Image operation are specified in the following table::

SOP Class Name	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Digital X-ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
Digital X-ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
Digital Intra-oral X-ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
Digital Intra-oral X-ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
Computed Radiography Image	1.2.840.10008.5.1.4.1.1.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Explicit VR Little Endian Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2

All these SOP classes conform to the standard Storage Services as specified in the DICOM 3.0 Standard.

3.2.2.2 Real-World Activity for Query Operations

DEXcom initiates associations for the transfer of query information from a DI-COM Image Storage Server.

DEXcom also inititiates associations for getting the Modality Worklist or part of it from a DICOM Worklist Server.

3.2.2.2.1 Associated Real-World Activity for Query Operations

Once the Query association has been established, a C-FIND message is sent and the responses from the remote application are waited for by DEXcom.

3.2.2.2.2 Presentation Contexts for Query Operations.

SOP Class Name	SOP Class UID
Patient Root Query/Retrieve Information Model - Find	1.2.840.10008.5.1.4.1.2.1.1
Modality Worklist	1.2.840.10008.5.1.4.31

3.2.2.3 Real-World Activity for Retrieve Operations

DEXcom initiates associations for the transfer of images from a DICOM Image Storage Server.

3.2.2.3.1 Associated Real-World Activity for Retrieve Operations

Once the Retrieve association has been established, a C-MOVE message is sent and the reponses waited for by DEXcom. If a C-STORE request is received from the remote application, DEXcom acts as a Service Class Provider (SCP) of the Storage Service Class.

3.2.2.3.2 Presentation Contexts for Retrieve Operations.

SOP Class Name	SOP Class UID
Patient Root Query/Retrieve Information Model - Move	1.2.840.10008.5.1.4.1.2.1.2

3.2.2.4 Real-World Activity for Verify Operations

DEXcom initiates associations for verifying communication with a DICOM Server.

3.2.2.4.1 Associated Real-World Activity for Verify Operations

Once the Verify association has been established, a C-ECHO message is sent and the responses from the remote application are waited for by DEXcom.

3.2.2.4.2 Presentation Contexts for Verify Operations.

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1

4 Communication Profiles

4.1 Supported Communication Stacks

DEXIS provides TCP/IP Network Communication Support as defined in PS 3.8 of the DICOM 3.0 Standard.

4.2 TCP/IP Stack

DEXIS communicates over the TCP/IP protocol stack on any physical interconnection supporting the TCP/IP stack. DEXIS inherits the stack from the operating system on which it executes.

4.3 Physical Media Support

DEXIS is indifferent to the physical medium over which the TCP/IP executes.

5 Extensions/Specializations/Privatizations

The following restriction applies to SOP instances of the VL Photographic Image Storage Class:

The tag "Photometric Interpretation" (0028,0004) shall have one of the values: RGB or MONOCHROME2.

There is no restriction on SOP instances of the Digital X-ray Image Storage Class and on the SOP instances of the Digital Intra-oral X-ray Image Storage Class.

The Application Entity uses private tags according to the following description:

Name of Private Tag	Tag	Description
Private Tag Range	(0029,0029)	Reserves the (0029,29xx) Range
Description	(0029,2920)	Environmental Description
Orientation	(0029,2921)	Computed Type and Orientation
Parameter 1	(0029,2922)	Various Parameters
Parameter 2	(0029,2923)	More Parameters
Teeth	(0029,2924)	ISO Tooth Descr.
Jaw	(0029,2925)	ISO Jaw Descr.
Quadrant	(0029,2926)	ISO Quadrant Descr.
CRC	(0029,2927)	CRC Check Sum

6 Configuration

The DEXIS Software can be set to store all images internally in DICOM image file format; if this setting is on, and all images are stored in DICOM file format, no conversion is done when importing or exporting images in DICOM format. Images not stored internally in DICOM format are converted when exported; these images also contain all the necessary information.

7 Support of Extended Character Sets

The DEXIS Software will only create SOP instances containing the DICOM default character set as defined in PS 3.5.

8 Codes and Controlled Terminology

The SOP Classes supported by this implementation require the Codes and Controlled Terminology for the Anatomy Imaged according to PS 3.3 C.8.11.2 which are fully supported.